

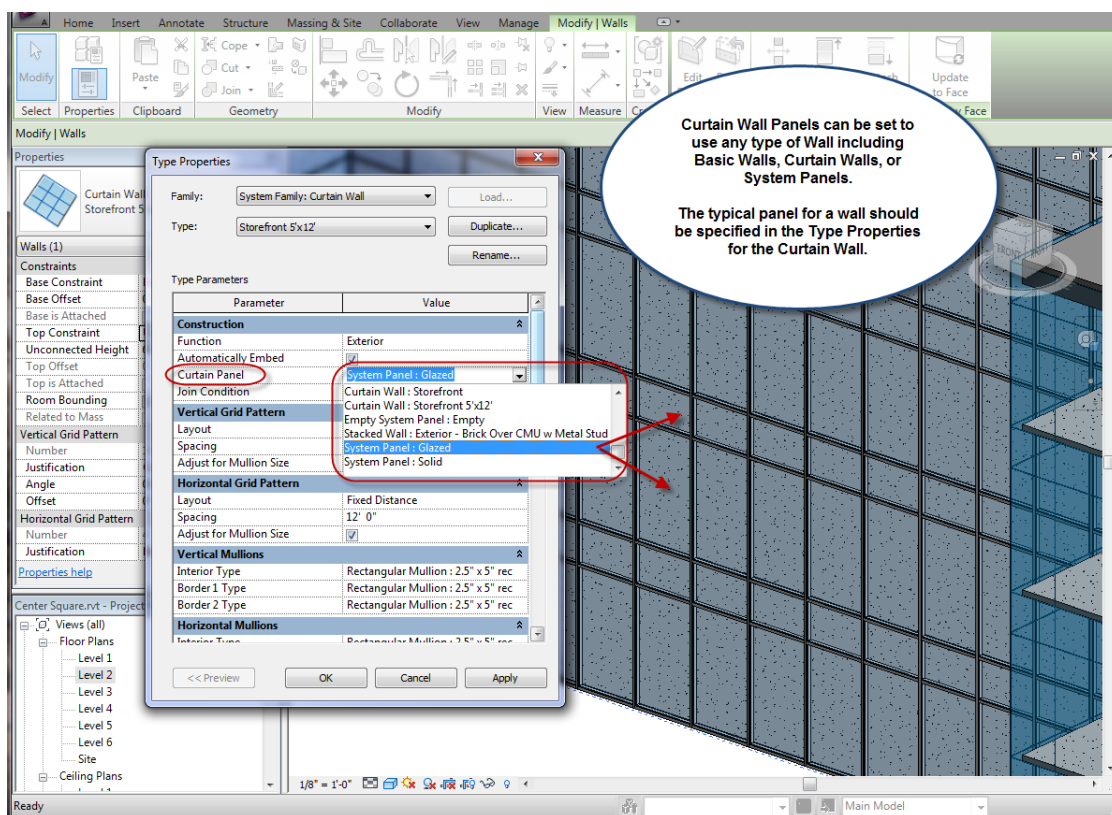
## AGENDA:

1. Curtain Wall Panels
2. Curtain Wall Mullions and Join Conditions

### 1. Curtain Wall Panels

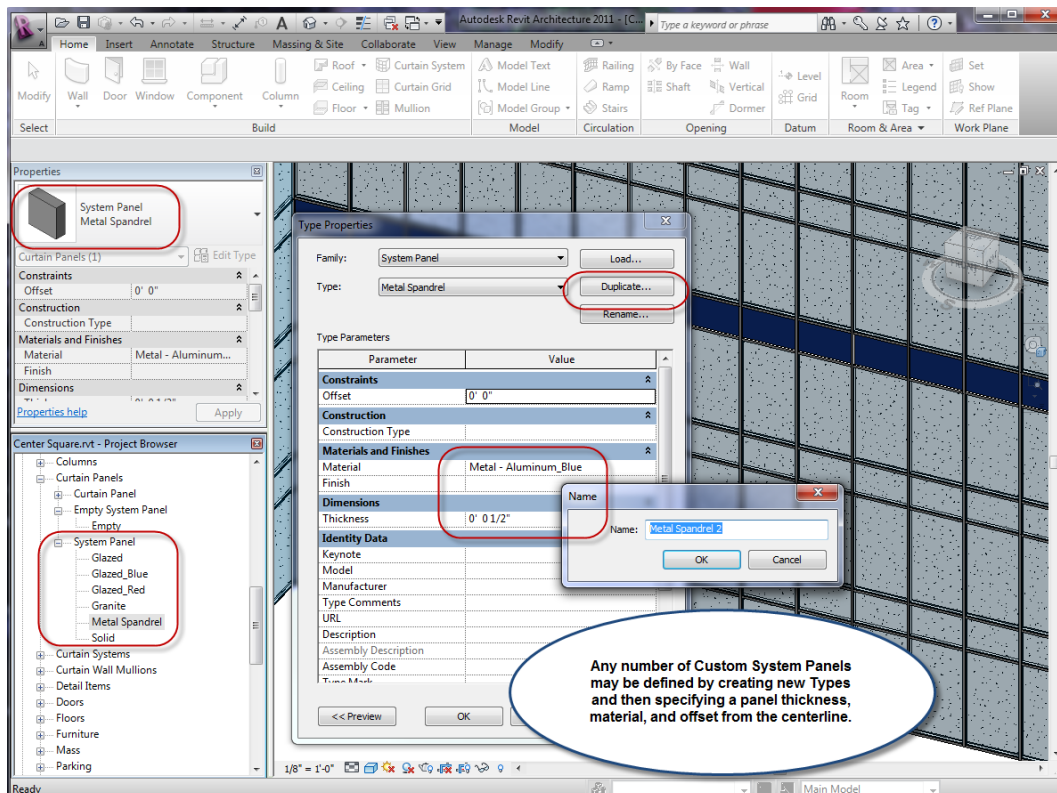
Revit allows you to change a curtain wall panel to any type of wall. You can use Basic Wall types such as a masonry wall, Curtain Wall types, or System Panel types.

Curtain Wall panel assignments are initially defined in the Type Properties by selecting a Wall type or System Panel in the Curtain panel assignment in the Construction parameters.



The most typical type of curtain panel, should be assigned via the Type Properties and then you can override selected panels to set them to different types. You cannot explicitly control the size of a panel with drag controls. Panel size and shape is determined by the Curtain wall grid layout.

There are 3 types of default System panels which can be assigned to Curtain Panels: Glazed, Solid, and Empty. You can modify the type properties for these panels and assign a thickness, offset distance, and material. You can also duplicate any of the default system panel types or create new types from scratch through the Project Browser.

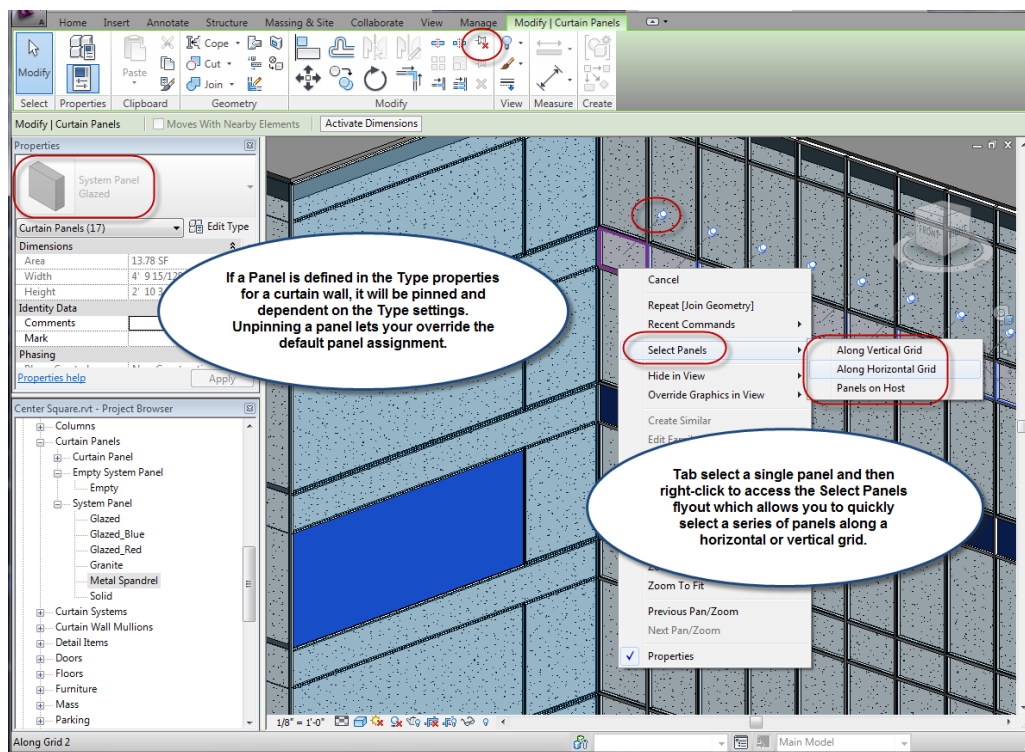


Creating new panel types will give you more flexibility in assigning different types of materials such as colored glazing, mirrored glass, opaque glass, solid metal panels, solid stone panels, etc .

Custom panel conditions can be created by selecting a single panel and then choosing the Edit in Place tool on the Ribbon. This will allow you to override the extrusion thickness, visibility settings, material assignments and subcategory for that one panel. You can also parameterize the visibility, material, or extrusion start and end values.

When an Edit in Place session is active you can also use sketch based modeling tools such as extrude, revolve, sweep, etc. to model new solids or voids to add material to the panel or to create holes in the panel. This would allow you to model an opening for an intersecting element such as a vent.

When a panel type is assigned in the Construction parameters for a Curtain wall type, all panels will initially be dependent on that setting. If you select a single panel on the curtain wall, it will display a pin control and you cannot modify its type. The type selector will show the currently assigned type but it will be greyed out.



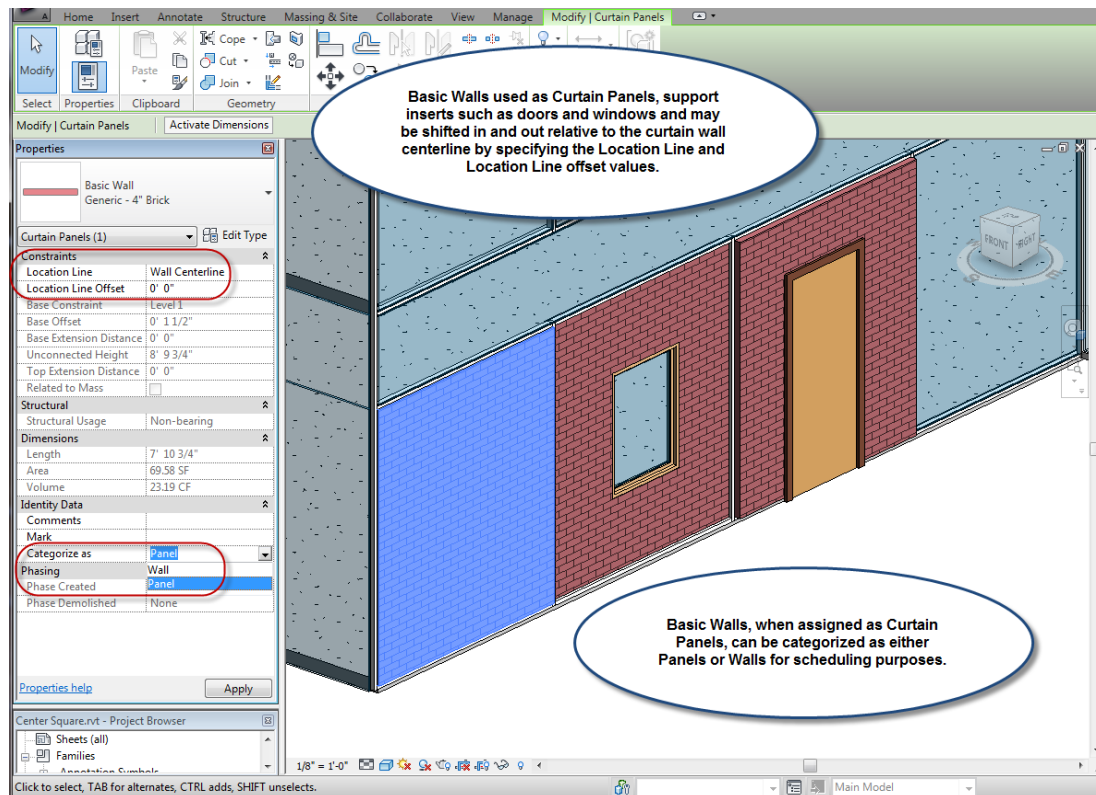
When you unpin a default panel, the type selector will become active and you can specify a new type to assign to the selected panel or panels.

To select a number of panels at one time, tab select a single panel and then right-click over the curtain wall to access the Select panels flyout. This will allow you to select all panels along a row, a column or all of the panels on the host curtain wall.

When multiple panels are selected, you will need to right-click directly over one of the selected panels, to access the Select Panels flyout a second time.

If you override a default panel assignment and then pin the panel again, it will revert to the default panel type assigned in the type properties.

When you use a Basic Wall type as a Curtain Wall panel, you adjust the position of the nested wall with the width of the Curtain wall by specifying a location line as Center line, Exterior Face, Interior Face, etc. and then fine-tune the placement by assigning a Location line offset.

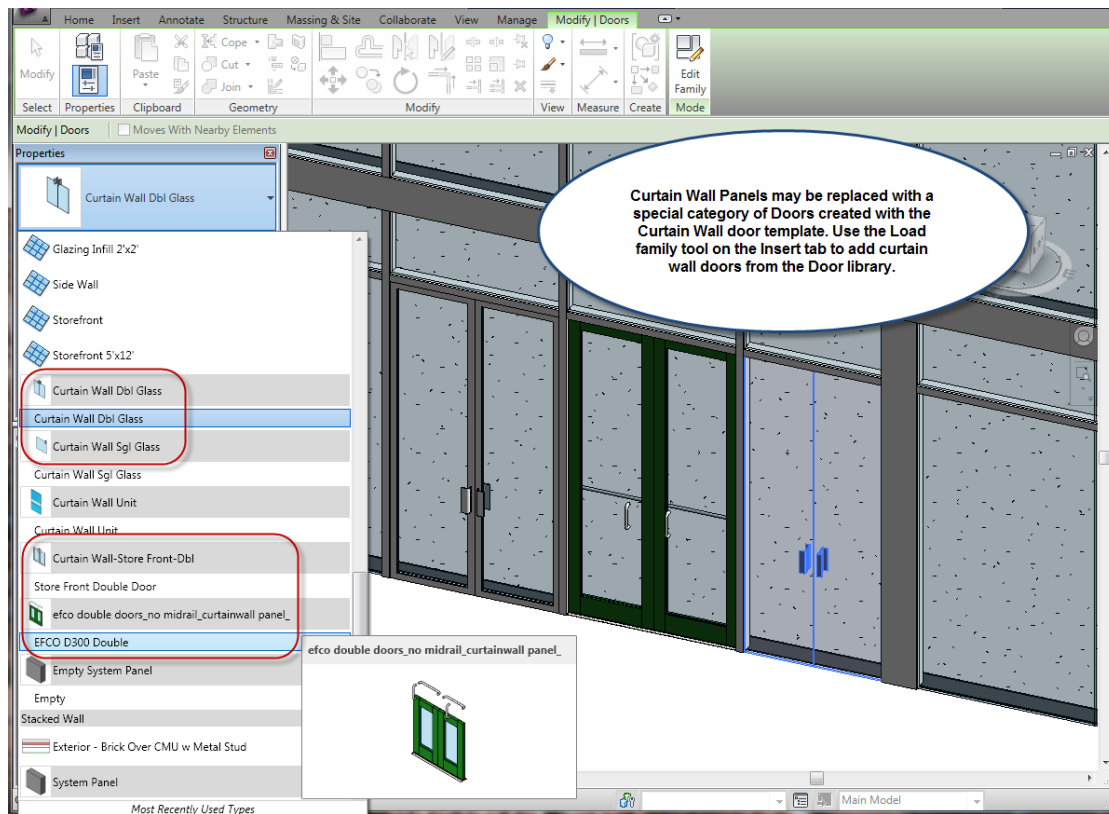


Basic Walls include a Categorize As parameter in their Identity Data properties which can be set to either Panel or Wall. This will affect how the element is scheduled and whether it will be used in Wall surface calculations.

It is possible to add inserts such as Doors and Windows to Basic Walls that are being used as Curtain Wall panels. If a panel containing inserts is resized or moved, the position of the inserted door or window will remain fixed relative to the overall Curtain wall. The insert will not move with the panel.

Wall Panels which use Basic Walls can be split by adding grid lines or grid line segments. If you delete a grid line segment adjacent panels will be merged. When a grid line between two different panel types is deleted, the resulting panel will use the panel type from the left side of a vertical grid line or the lower side of a horizontal grid line.

To add doors to Curtain Walls, load doors created with the Door - Curtain Wall template. You can find three examples of single and double glass doors in the default doors library and more are available on the Autodesk Seek website. If you check other Revit content sites on the internet, you will be able to find revolving doors as well. After downloading the content, load it into your project so you can access it while swapping panels.

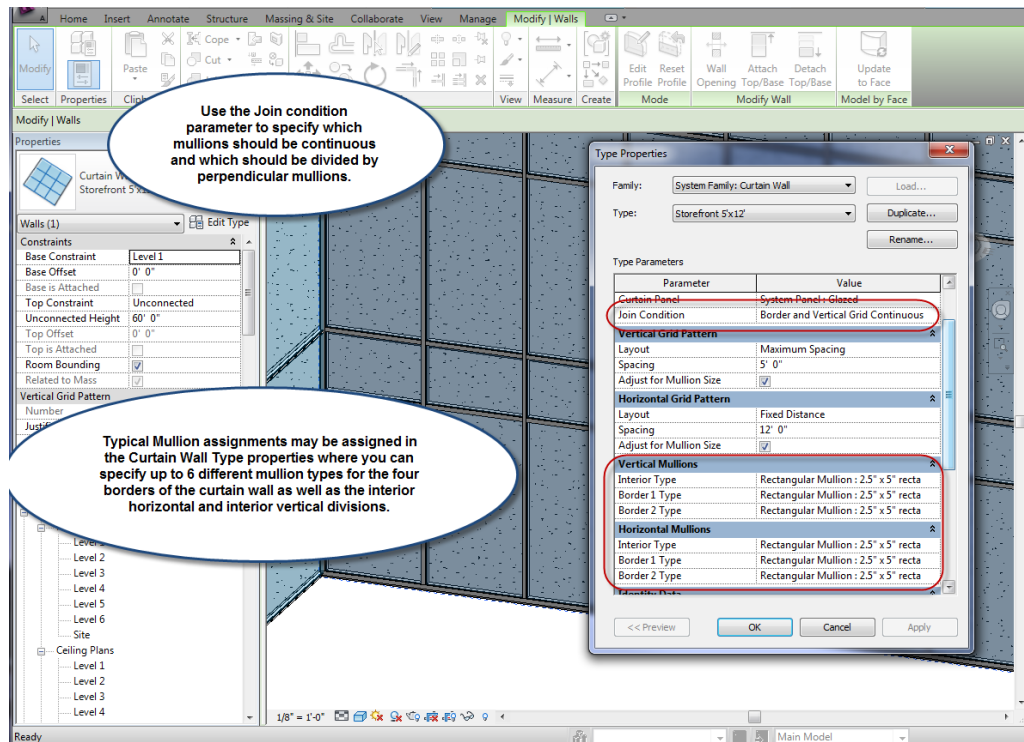


Curtain wall doors may not be added with the Door tool unless you are using a Basic Wall type as a curtain panel. To add Curtain doors to Curtain panels using the System Panel assignments, add grid lines as required to set the size for your single door or double door assembly. Then tab select the curtain wall panel, unpin it if necessary and then select one of the Curtain wall "door" panels you have loaded into your project.

The default curtain walls preloaded with the Revit library of doors display correctly in a plan view, showing symbolic swings for the doors and including flip grips to reverse the hinge side for single doors and the swing direction for single and double doors.

## Curtain Wall Mullions

Curtain wall mullions are the 3D elements which are aligned with the Curtain Wall Grid lines and divide the Curtain wall into discrete panels. As with the Curtain Panel types, the most typical mullion assignments are best defined in the Curtain Wall type properties.



The Curtain Wall type properties allow you to assign mullions for the Vertical and Horizontal grid directions. Within each direction category, Mullions are defined as Border Type or Interior Type. You can specify different profiles and sizes for up to six different variations.

When you add mullions to a grid, the overall dimensions of the grid remain the same and the panels will get smaller. Border mullions are constrained to the outer dimensions of the wall. Interior mullions are centered on the grid lines by default although this can be modified.

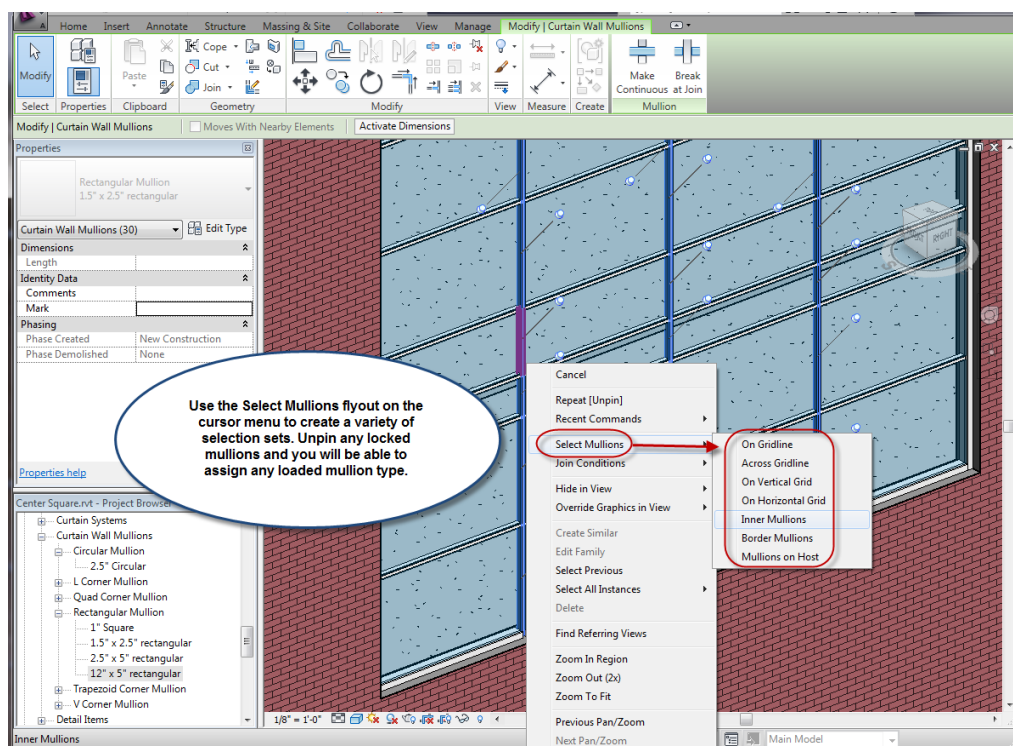
The Join condition setting in the Construction parameters allows you to select a starting condition for how you wish the mullions to appear at intersections and corners. The larger elements are usually set to be continuous. This can be modified later if required.



Default mullion types use circular, or rectangular profiles and come in 4 preset sizes. You can duplicate these predefined types or create new types in the project browser to create any number of size variations.

Interior mullions are centered on the grid lines by default but it is possible to override this by editing the dimensions in the mullion type. Instead of a single width dimension, you can specify a distance from the grid center line out in either direction with a width to Side 1 or Side 2. By setting one value to 0" you can justify a mullion to one side of the grid line.

To override default mullion assignments pick one mullion, right-click and use the Select Mullions flyout to create a selection set from a number of options. If any of the mullions are pinned and are being controlled by the Type Properties, you need to Unpin the selection set to be able to assign a new mullion type in the Type Selector.

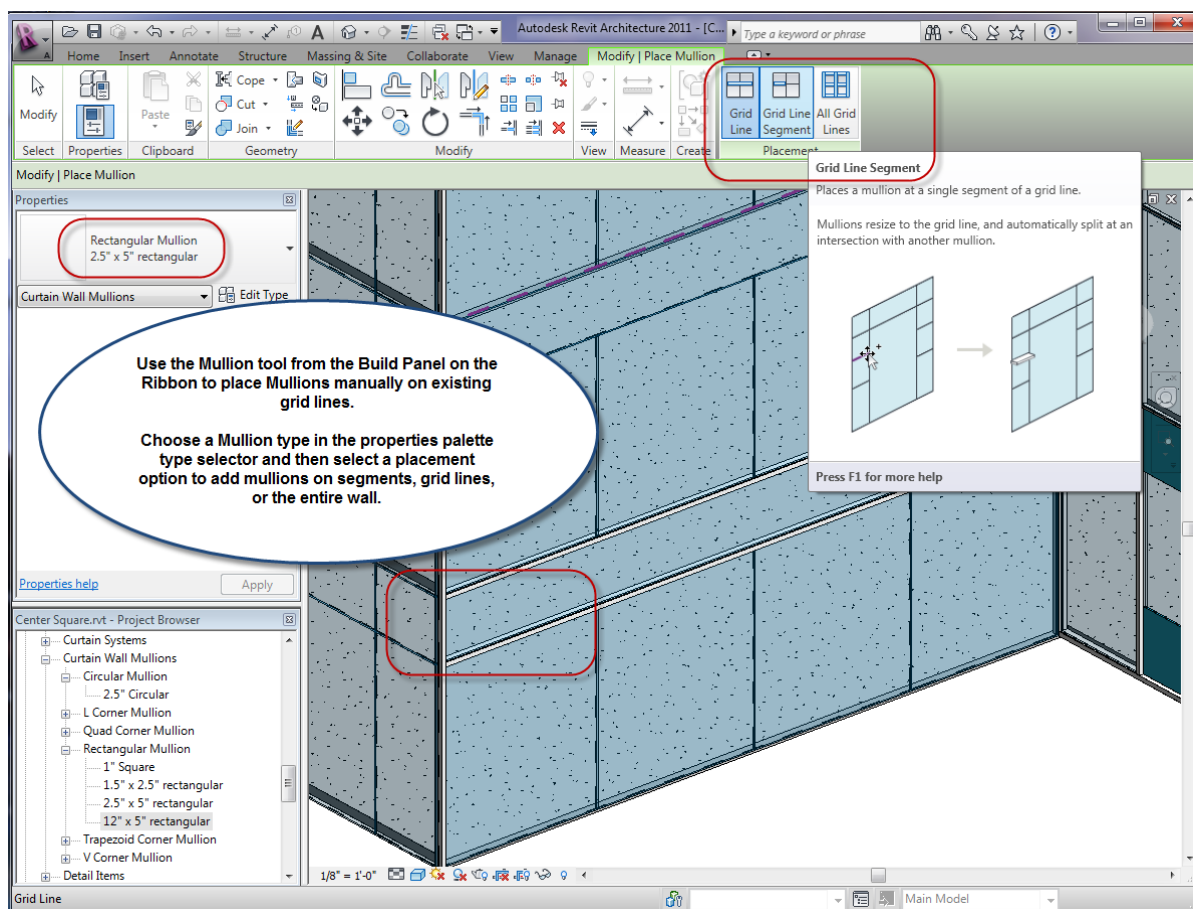


To revert a selection set of mullions back to their default Type controlled mullion assignments, create a selection set and then Pin them. There is also a Select Mullions option in the curtain wall shortcut menu but it has fewer option than when using the Mullion shortcut menu.

Mullion Types include an Angle and Offset parameter which can be used to shift the mullion in or out from its default position and rotate the profile around its linear axis .

Mullion types use a position parameter which by default will rotate a profile so that it is perpendicular to its face. For sloping curtain walls ,you may want to change this setting to Parallel to Ground.

Mullions may be placed manually on any existing grid lines which do not already have mullions assigned. The Place Mullion tool is accessed from the Build panel on the Home tab of the ribbon. When adding mullions manually, you can preselect the mullion type in the properties palette. If desired, you can open the type properties and duplicate an existing type to create a new size.

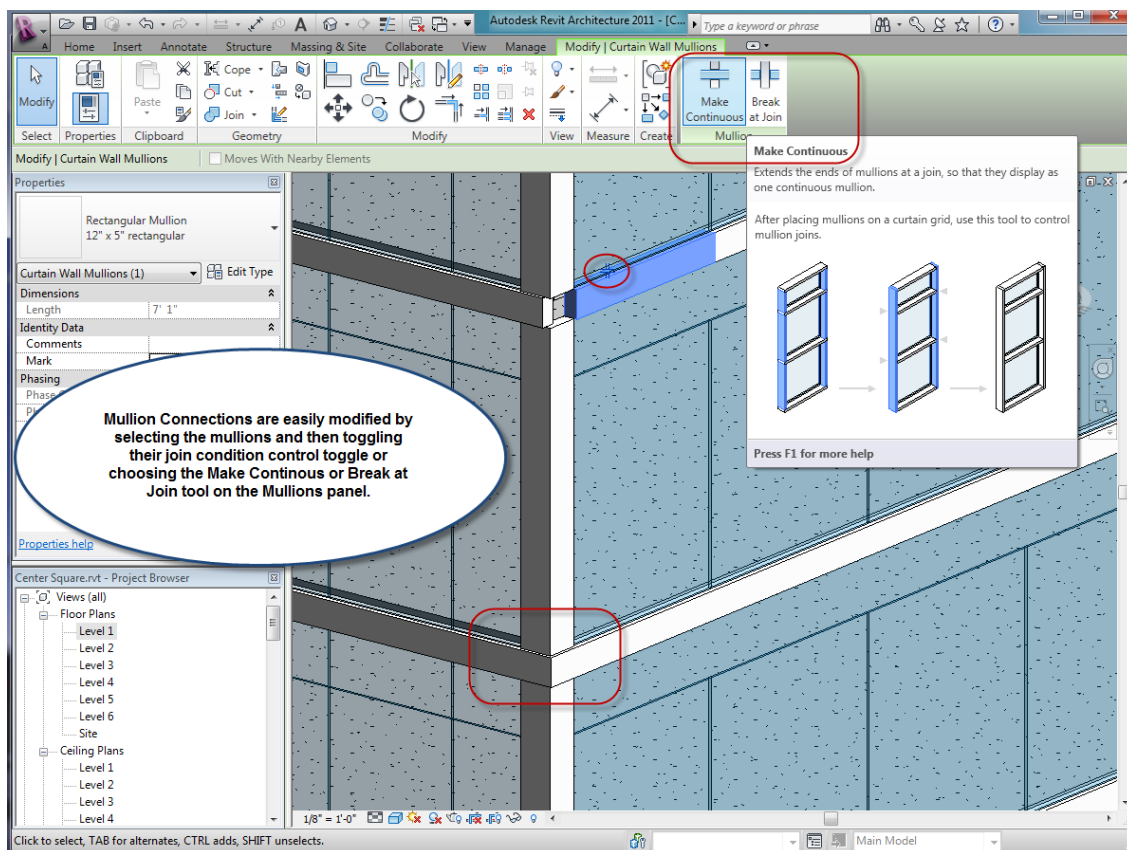


Choose a placement option to add mullions all along a single grid line, on just one grid line segment, or on all grid lines for the entire grid.



Mullion joins will initially follow the settings from the Type properties for the curtain wall join condition parameter. Here you can specify whether the horizontal mullions should cut through the vertical mullions or vice versa. Usually the Border mullions will be continuous and if there are different sizes for interior type mullions, the larger mullions will be continuous.

To override the default mullion join conditions for one or more mullions, select a mullion, optionally expand the selection set, and then choose the Make Continuous or Break at Join tool from the Mullion panel.

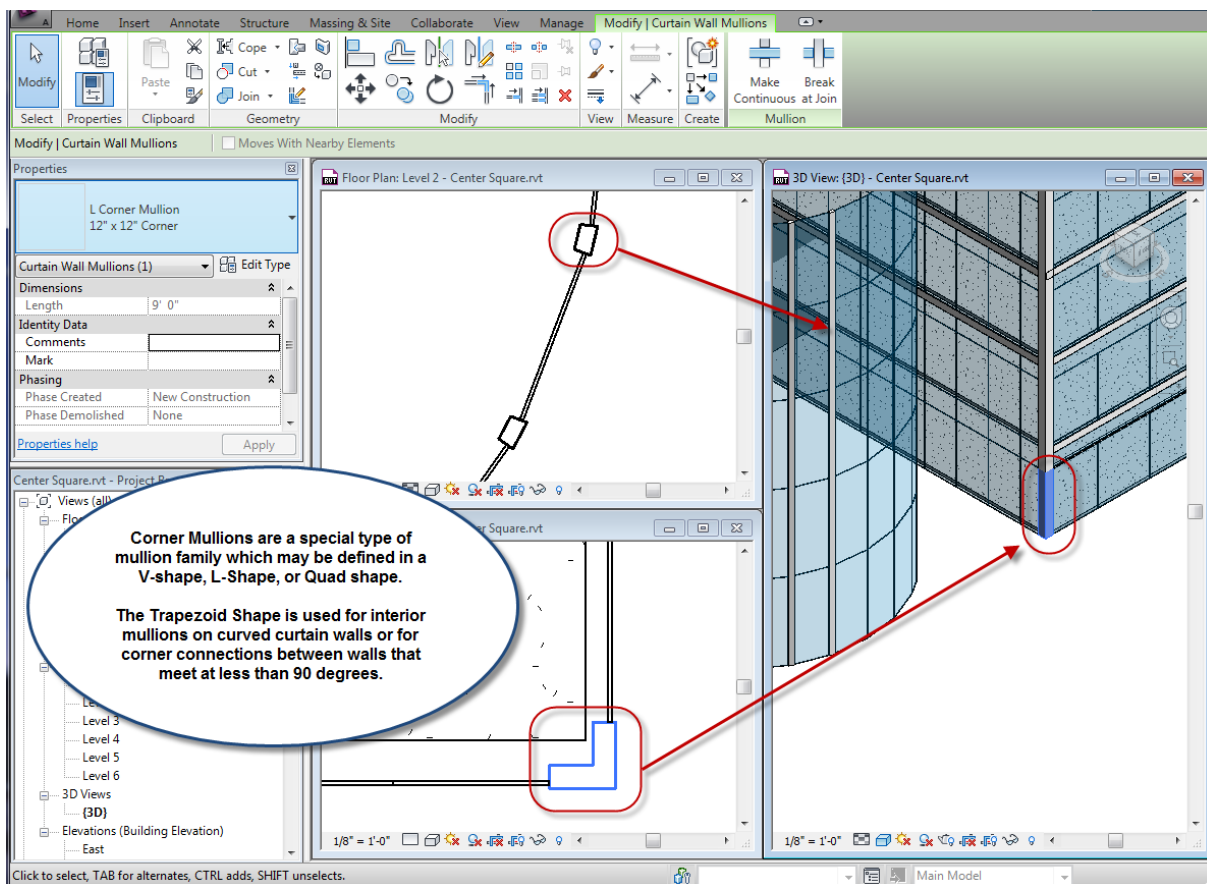


When you select an individual mullion it will display a “Clean Join” toggle icon at both ends. Picking this toggle will override how the intersecting mullions clean up at that location.

When two adjacent curtain walls meet at a corner the horizontal mullions should miter and clean up around the join. Use the Clean Join toggle if necessary to help this condition if the mullions do not miter correctly automatically.

Corner Mullions are single mullions which can be used to clean up the intersection between two adjacent walls. They may also be used as interior vertical mullions on curved curtain walls.

Corner mullions come in 4 predefined shapes. The L-Shape and V-Shape mullions are used for typical 90 degree corners and you can specify the length and thickness for each leg in the type properties. The Trapezoid Corner and Quad Corner mullions can accommodate additional angled joins such as those found between panels on a curved curtain wall or where two curtain walls meet at a non-right angle corner. Additional Corner mullion types may be created as required.



Use the Mullion tool on the Build panel to add corner mullions to grid lines or select all of the existing mullions along one end of a curtain wall, unpin them if required, and then select one of the corner mullion types in the build panel. If you get a warning that the new corner mullion entirely overlaps the border mullion on the adjacent wall, choose the Delete elements option to continue and remove the buried mullions.

## Exercise Notes

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- In the following exercise you will learn how to work with Curtain Wall Mullions and Panels, create new mullion and panel types and work with nested curtain wall units.
1. Start Revit and open the Center Square project. Select one of the wing walls with the Exterior Glazing 5'x12' curtain wall type. Choose Edit type and rename the type to Exterior Glazing 6'x12'. We're going to switch to a standard 6 foot wide panel along the horizontal walls. Set the Vertical grid to Maximum Spacing with a value of 6'-0".
  2. Under Constraints, set the Curtain panel to System Panel: Glazed. Set the Join condition to Border and Horizontal Grid continuous. Set all four Border type mullion assignments to use Rectangular Mullion: 2.5" x 5" rectangle. Set the two interior Type mullions to use the Rectangular Mullion 1.5"x2.5" rectangle. Pick Apply and Ok to close the dialog.
  3. Zoom in to the base of the wall where you can examine the condition where the panel and two mullions meet. The glass panel is in front of the interior mullions. In the Project Browser, expand the families category to Curtain Wall rectangular mullions and pick the 1.5" x2.5" type. Right click on the name and choose Type Properties. The thickness is 2.5" and the offset is zero. That means there is 1.25" from the interior mullion to the border mullion. Set the offset to 1.25" and pick Apply.
  4. Access the material dialog and create a new material by duplicating the Metal-Aluminum. Create a color variation of your choice and then apply this new material. Pick Apply and Ok. Open the type properties for the 2.5"x5" mullion and assign the new material here as well. Increase the dimensions to 2.5" for each width and then rename the type to 5" x 5" rectangle. Pick Apply and OK.
  5. Still zoomed in on the panel mullion connection, select the System Panel Glazed in the Project browser and open its Type Properties. Reduce the offset to 0" and apply. Set it to 1/2" and apply. Reduce the glass thickness to 3/4" and pick OK. Open the materials parameter and assign the Glazing Curtain Wall material. Pick Ok.

6. Zoom back a bit and pan to the edge of the building. From the Build panel on the ribbon, choose the Curtain Grid tool and with All Segments selected add a new grid line 3 feet above each floor level.
7. We are going to use two different solid panels, one to cover the ceiling and floor assembly space from 9 feet to 12 feet and a second to cover the first 3 feet above floor level to a 36" window sill height. The lower section will use a stone panels and the top section will use an opaque glass (solar?)panel. Open the System Panel category in the Project Browser and Duplicate the Solid type. Call the new type, Granite and then open the Type properties. Reduce the thickness to 1 ½". Open the material dialog and duplicate the Masonry Stone material. Choose Replace and then select the rough red granite material. Assign the new material and then Apply the changes.
8. Duplicate the System Panel Granite Type and create a new type called Glass\_Black\_Solar. Reduce the thickness to ¾" and increase the offset to 2". Create and assign a new material with a pure black color. Pick Apply and Ok.
9. Zoom in to the lower corner of the building and tab select one of the panels in the bottom row. Right click and choose Select Panels / Along Horizontal Grid. Pick the UnPin tool and then open the Type Selector in the properties palette and assign the System Panel: Granite panel type.
10. Repeat the previous step for each of the levels on this wall. After assigning the Granite panel to each of the lower 3 foot sections, repeat the process for the upper 3 foot sections. Assign the Glass Black panels to the top panels on each level.
11. Duplicate the 5" x 5" rectangular Curtain Wall mullion and create a new mullion called 10" x 5" Floor Band. Set the dimensions to Width on Side 2 to 0" and the Width on side 1 to 10". In the Material parameter, assign the Metal-Aluminum material and set it to use Render appearance for shading. Apply and Ok to close the dialogs.
12. Pick one of the horizontal mullions at the second floor level. Right click and choose Select Mullions / On grid line. Pick UnPin and then assign the new floor band mullion. Repeat for each floor level and also the top border edge.

13. Duplicate the 10" x 5" Floor Band mullion type and name the new one 10" x 5" Column. Use the Metal Aluminum material and set the two width dimensions to 5" each so the mullions will be centered on the grid line. Pick Apply and OK.
14. Select a mullion on the middle, vertical grid line and expand the selection to all mullions on the grid line. Unpin the selection, assign the new column mullion and then choose the Make Continuous option on the Mullion Panel. Repeat for the two vertical grid lines located 12 feet to either side of the middle grid line. This will divide the wall into four major vertical divisions.
15. Select one of the horizontal mullions at the top border of the curtain wall. Expand the selection to the entire gridline and choose the Make continuous option.
16. Change your view so you can work on the adjacent curtain wall which started as the default Curtain Wall 1 type and which had grid lines added manually. Select the curtain wall and change its type to the Exterior Glazing 6'x12' type. This will populate the curtain wall with mullion assignments and add a few new grid lines as well in addition to the manually added grid lines we created in the previous class. The combination looks good so we are going to retain the initial grid layout, add a few grid lines at 3 feet above the floor level and then override some mullion and panel assignments.
17. Add Curtain Grid lines at 3 feet above each grid line. Select one of the horizontal mullions at the second floor level, expand the selection to the entire grid line, unpin the mullions and assign the Floor Band mullion type. Repeat for each floor level and the roof level.
18. Select the vertical mullion to the left or right of the middle grid line. Expand the selection, unpin the mullions, assign the column mullion type, and choose Make continuous. Repeat for the corresponding vertical mullions on the other side of the middle grid line. This will define three major vertical bays in the wall.
19. Select panels along horizontal grid lines, unpin and assign the Granite panels and the Glass Black panels to correspond with the assignments on the adjacent wall.

20. Zoom in to the lower portion of the wall where there are two narrow bays next to one of the main column mullions. The panels are not equal sizes because the panel dimensions are being measure from center line to center line on the adjacent mullions. Tab-select one of the panels and check its width. Tab select the adjacent panel and check its width. Calculate the difference in widths and divide by 2. The answer is the distance we need to move the grid line between the two panels to make them equal widths.
- ie. -  $2'-6.5 - 2'-2.25 = 4.25$  and  $4.25/2 = 2.125$
21. Tab select the grid line between the two narrow panels. Unpin the grid line and choose Activate dimensions if the temporary dims do not appear. (you may need to zoom back and pan up a bit to see the dims.) Pick one of the dimensions and adjust its values as per the calculations in the previous step. Repeat this process for the grid line between the other set of narrow panels.
22. In the bottom middle pair of panels between the two column mullions we are going to create a new opening for a set of glass double doors. Before we start merging panels, go to the Insert tab and choose Load Family. Open the Doors folder and select the Curtain Wall Dbl Glass door type and the Curtain Wall – Store Front-Dbl door type and then pick Open to load them into the current project.
23. Zoom in and tab select a panel to check the available space. We have approximately 10 feet of space between the two column mullions. This will accommodate a set of 3 foot double doors with 2 feet on either side. First we need to remove a couple of grid segments.
24. Tab-select the horizontal grid line at 3 feet above the floor. Use the Add Remove Segments tool and pick the two segments between the two column mullions. The granite panels should expand up to the 9 foot height. Tab-Select the vertical grid line at the middle of the bay. Notice that this grid line already appears dashed in sections where mullions appear. This indicates that a manually placed grid line is stacked on top of a Type driven grid line. If you continue to Tab select along this edge, you will notice two that there are two grid lines which will highlight. Delete one of the grid lines.



25. Depending on which of the grid lines is deleted, you may receive a warning and you may also have to reassign some mullions or panels around the top of the wall. Clean it up as required and then zoom back to the area where the door is required.
26. Tab select the grid lines in the door area and Remove segments until you have a single large panel between the columns. Tab-select this panel and then pick the Pin tool and it will revert to the default glazed panel. Unpin the panel and in the Type Selector choose the Curtain Wall Dbl Glass panel.
27. Tab select the mullions at the bottom edge of the door. Use Tab and CTRL to select both mullion segments below the door. Unpin if either show a pin control and then delete them. The glass doors should expand to the floor level.
28. Tab select the door panel and check its width. The overall width of 9'-10" is too wide for a set of doors. We can either add a couple of grid line segments or we could reduce the spacing between the two main column grid lines. The latter would be easier but as usual we'll take the tricky approach. 😊
29. Tab-select the double doors panel and pick the Pin tool to switch the panel to the default glazed panel and then pick the UnPin tool. Select the Curtain Grid tool and try adding a single segment about 1.5 feet in from the main column mullion. If the single segment method fails, use the All Except Picked method instead. (not sure why one segment fails in this area, but I had to use All Except Picked to get it to work.) Repeat this process to add a second vertical grid line next to the other column mullion.
30. Tab select one of the new grid lines, choose the activate dimensions button on the Options bar and then set the dimension to 2'-0" from new grid line to the center of the column grid line. Repeat for the other side.
31. Tab-select the main middle panel and replace it with the Curtain Wall Dbl Glass door again. Tab select the mullions below the door and delete them.
32. Tab select the horizontal grid line at 3 feet above the floor and choose Add Remove segments to add a division through the sidelights on either side of the doors.

33. Tab select the double door panel to check its dimensions. The width at about 6'6" is good but the 9 foot height is a bit tall. Use the Curtain Grid tool again and use the All Except Picked method to create a single horizontal division above the double doors and 1'-6" below the 9 foot grid line.
34. You might need to do some repairs to the floor band mullions and the main column mullions at this point. Use select mullions on grid line, unpin, assign the correct type again if necessary and then use the Make Continuous option.
35. Select one of the mullions at the outside corner between the two curtain walls on which we have been working. Select mullions on grid line, unpin them and in the Type selector pick the L-Corner Mullion – 5" x 5" Corner. Choose the Make Continuous option. Accept the warning that overlapping mullions will be deleted. This is normal. If any of the floor band mullions are overlapping the corner mullion pick the horizontal mullion and use the Clean Join toggle to adjust the connection. Repeat as required.
36. At the outer corner where the first curtain wall meets the brick wall, pick one mullion, expand the selection and unpin the mullions. Assign the Quad Corner 5" x 5" Mullion. Although the L-corner is also described as 5" x 5", this refers to the length of the legs and the overall width is 7.5" on each side. Edit the Quad Corner 5" x 5" type properties and increase both dimensions to 7.5". Rename the mullion type accordingly.
37. Check the dimension between the outer face of the brick wall and the outer face of the quad corner mullion. (3-3/4") Pick the curtain wall and choose Activate dimensions. Select the 48' dimension and reduce it to 47'-8.25" so the corner mullion will shift over and align with the brick face of the wall.
38. Review the connections on both walls and make any minor adjustments as required. Save and Close the file. We will continue with the main front wall in the next lesson when we learn how to create custom curtain wall panels for linear curtain walls. Save and close the file.